CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

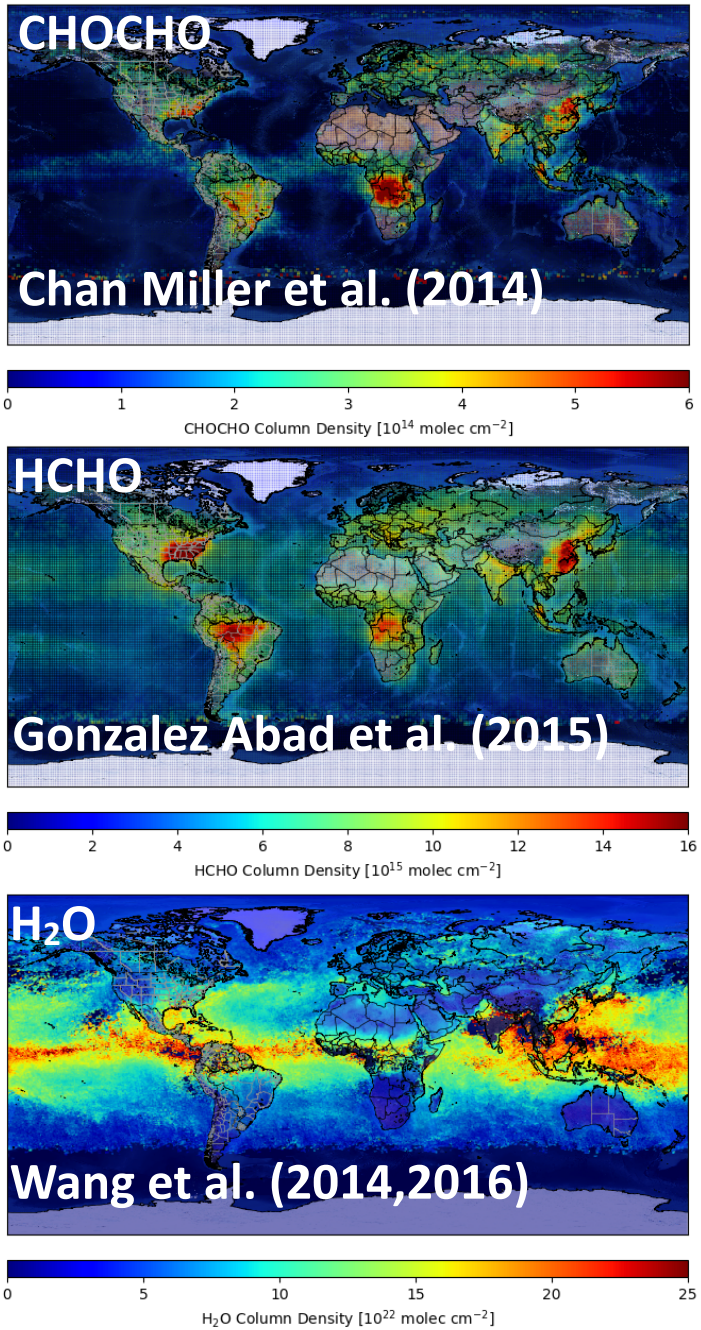
Long-term satellite data records of HCHO, H_2O and CHOCHO

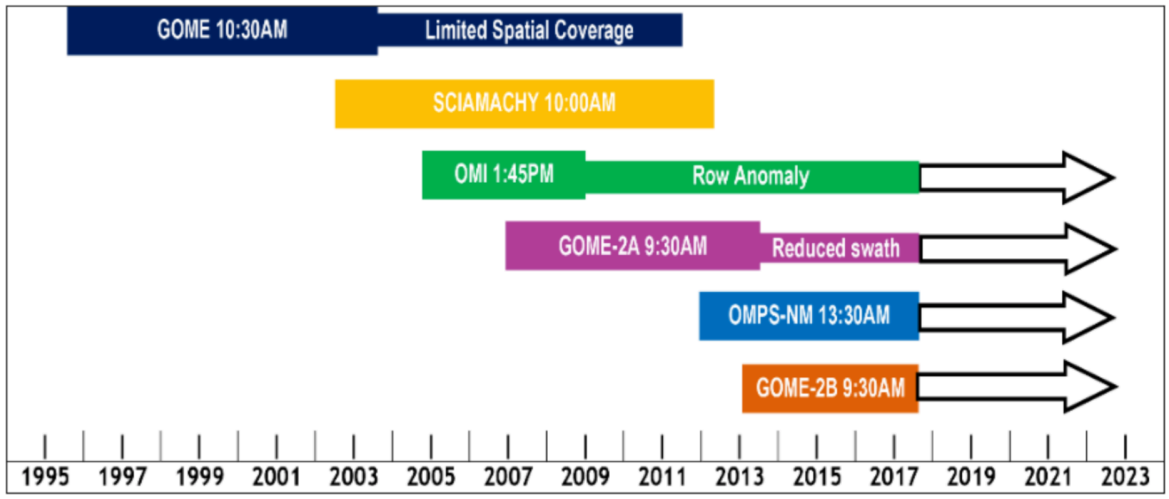
Introduction to OVOC/water vapor datasets for MEaSUREs

Christopher Chan Miller, Gonzalo Gonzalez Abad, Caroline Nowlan, Helen Wang, Kang Sun, Ewan O'Sullivan Xiong Liu, Kelly Chance

29th August 2019

MEaSUREs will build on existing SAO algorithms to retrieve targets using observations from 6 instruments





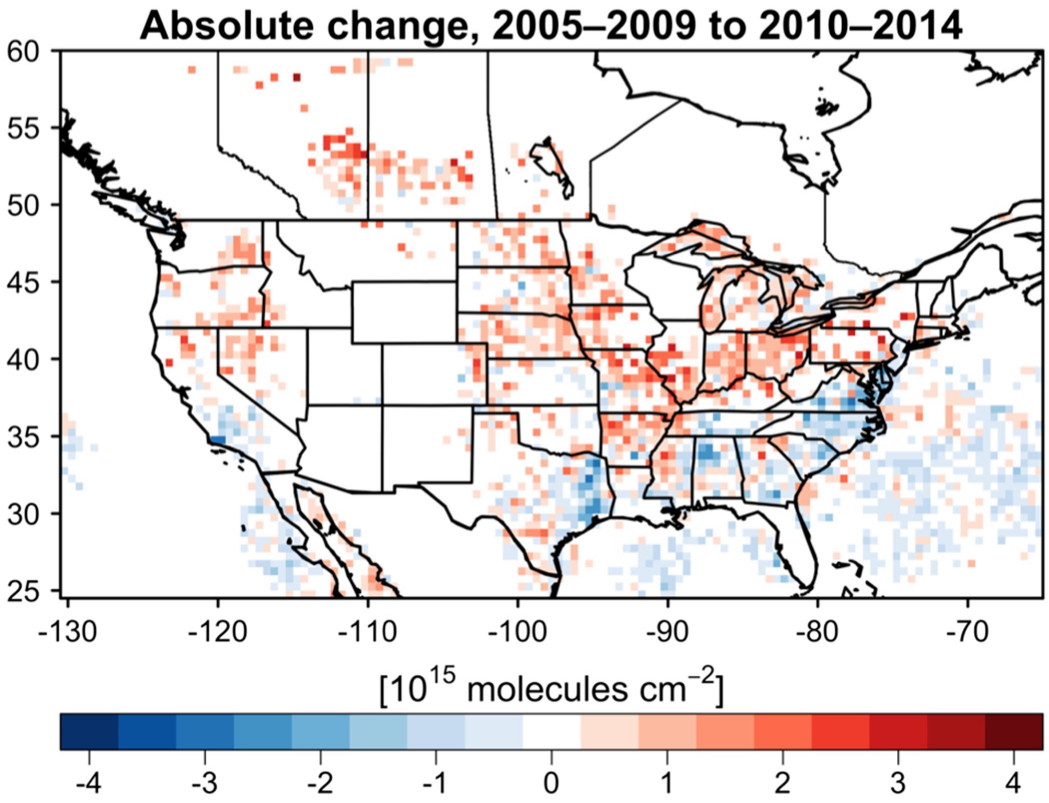
Base code for all algorithms will be shared with TEMPO

Product will include algorithm traceability chains and error characterization borrowing from past projects e.g. QA4ECV (Boersma et al., 2018)

Instrument Retrievals done in two phases:
(1) OMI, GOME-2, OMPS (overlapping validation data)
(2) GOME, SCIAMACHY (validation via correlation with products from (1)

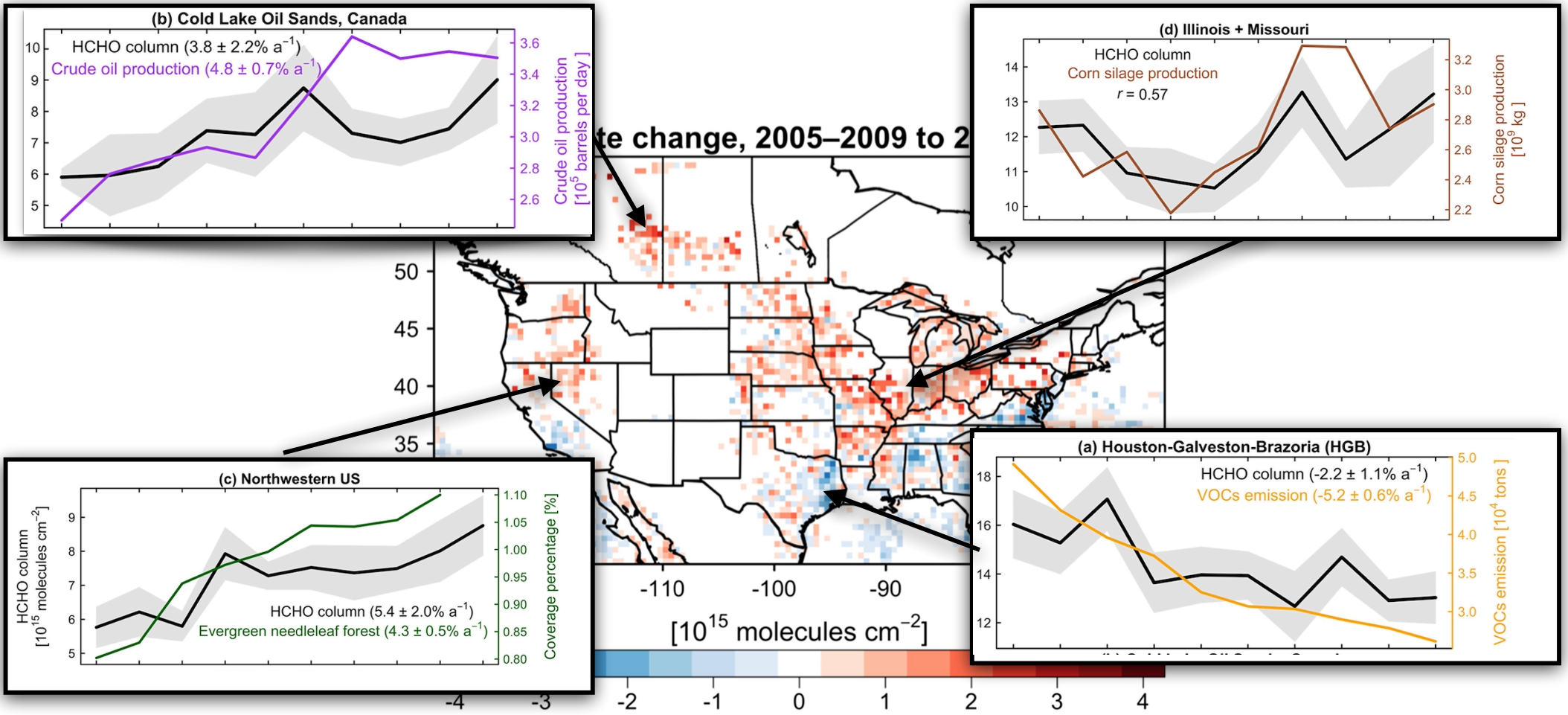
CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

Reliable long-term HCHO/CHOCHO observations will improve emissions attribution through temporal correlation



Zhu et al. (2017)

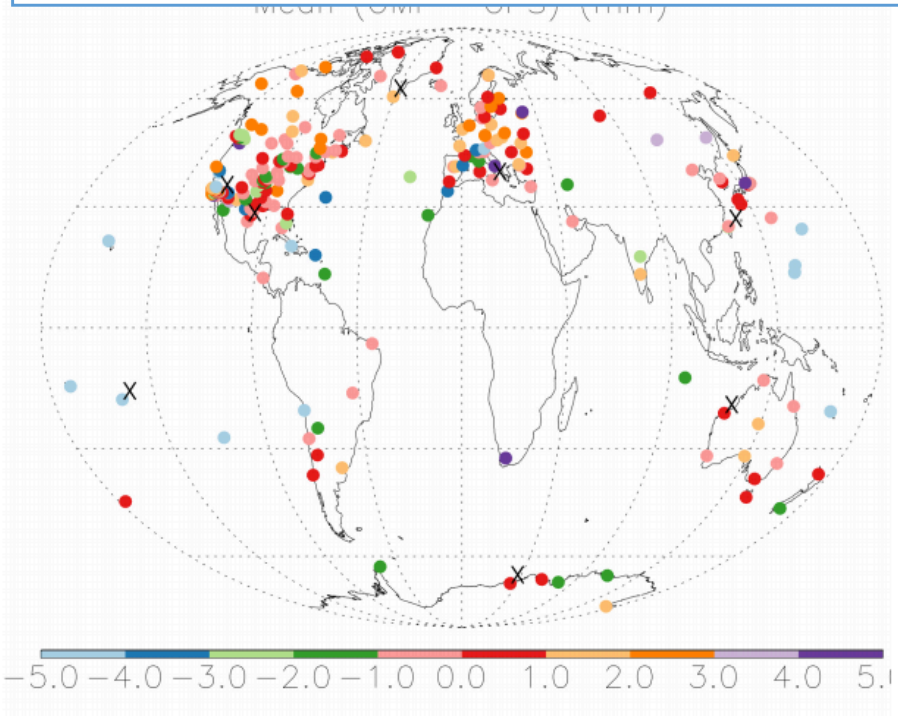
Reliable long-term HCHO/CHOCHO observations will improve emissions attribution through temporal correlation



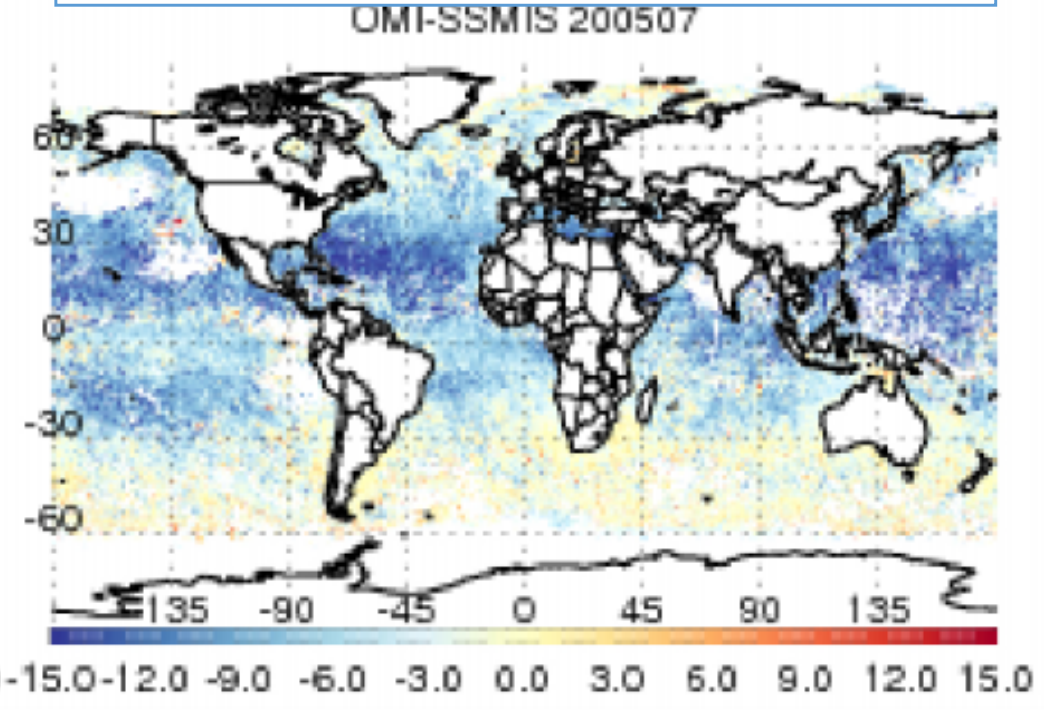
Zhu et al. (2017)

Water will be used as a fiducial reference for instrument harmonization

NCAR GPS Network



SSMIS Microwave Satellite Obs.



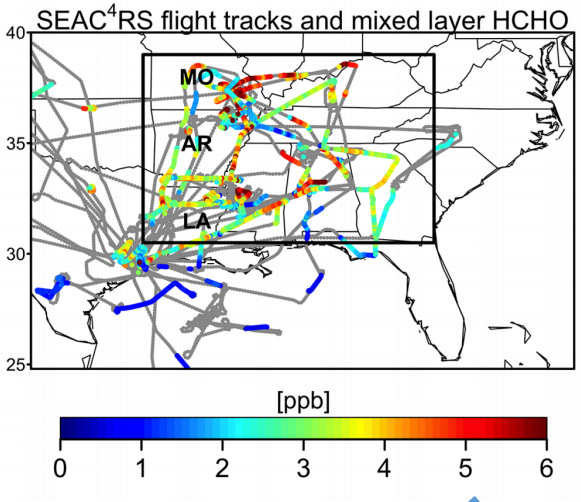
Wang et al. (2016)

Good-quality long term records exist for the entire MEaSUREs period enabling inter-sensor validation

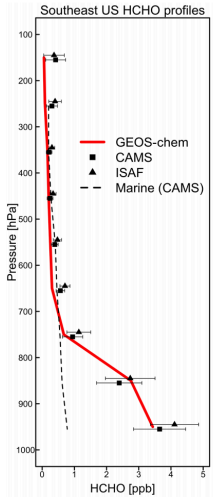
CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

HCHO and CHOCHO will be indirectly validated using CTMs combined with aircraft observations

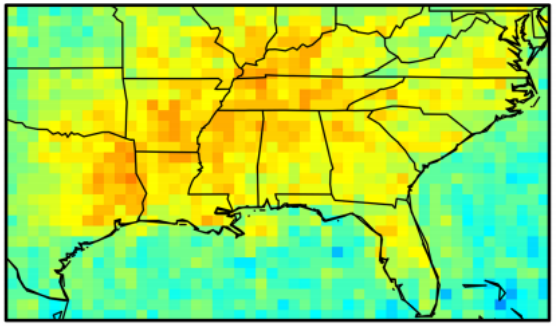
Aircraft Observation



Shape Factor Validation

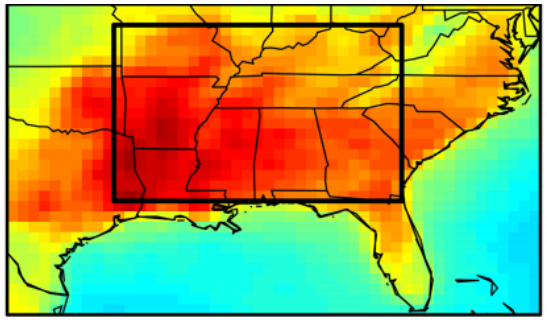


Satellite VCD with Improved shape factor



Validation

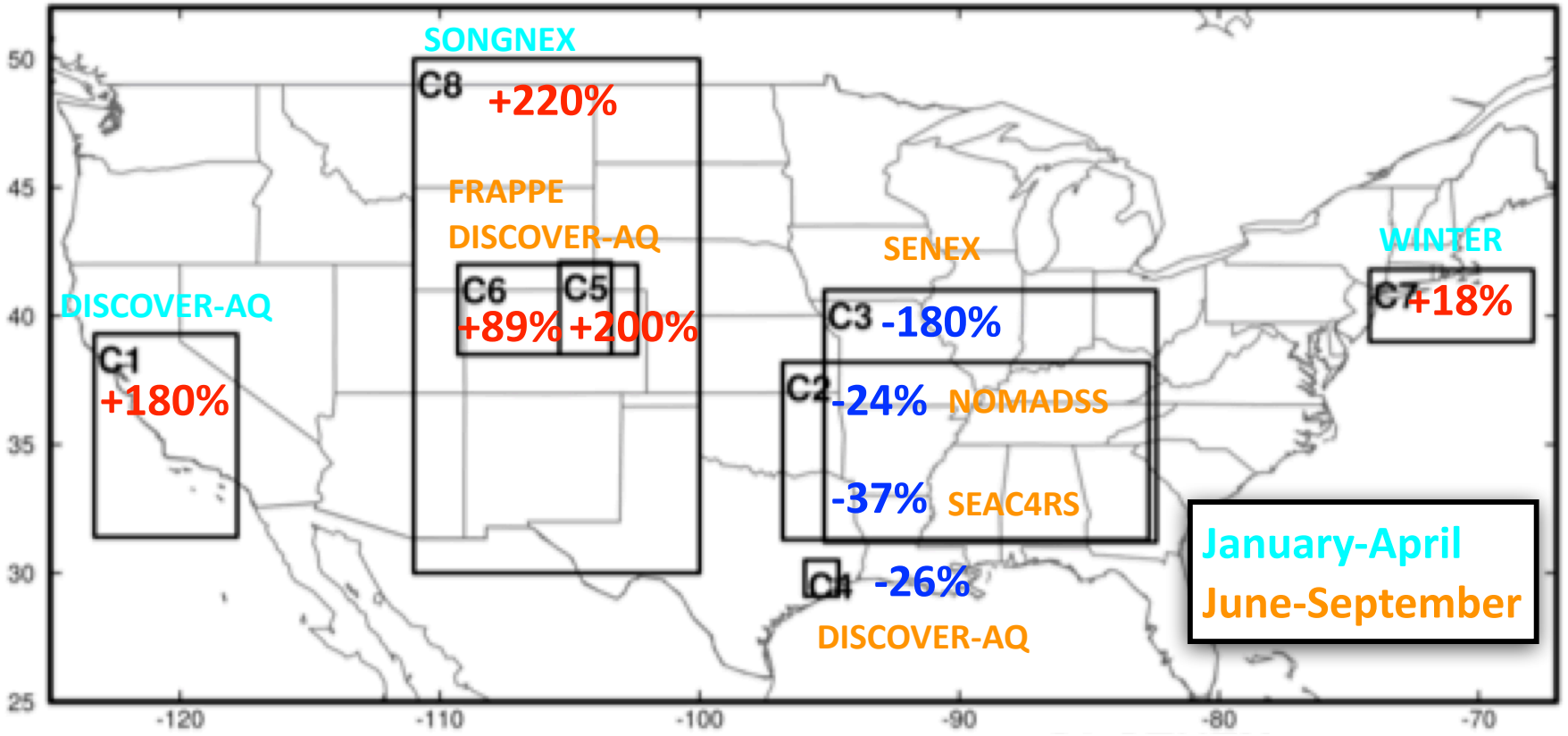
Observation-Informed Model VCD



GEOS-Chem CTM

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

HCHO and CHOCHO will be indirectly validated using CTMs combined with aircraft observations



Biased low over high-concentration regions and low over background areas

Adding additional campaigns: TORERO, CONTRAST, ATom, WE-CAN, LMOS

Algorithm Flow

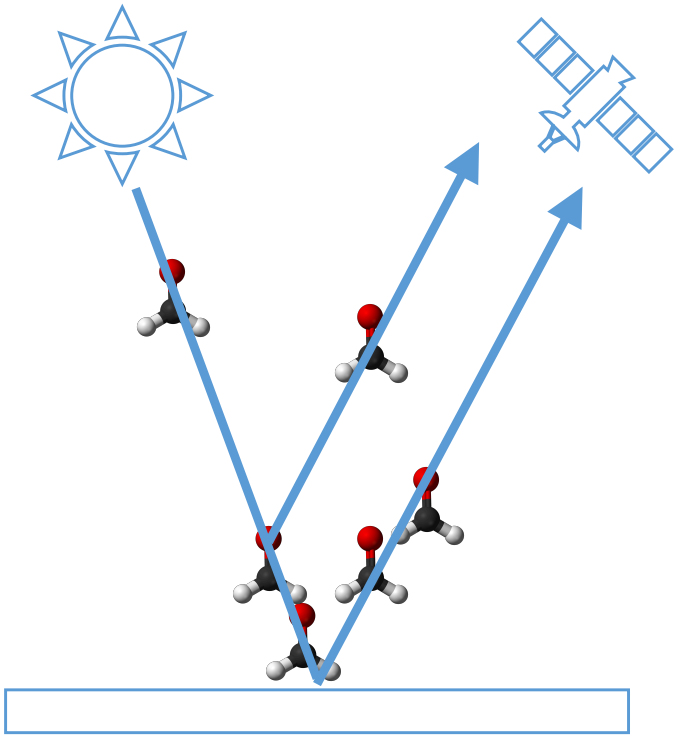
Key Datasets

Level 1 Radiance
Radiance Reference "I_0"

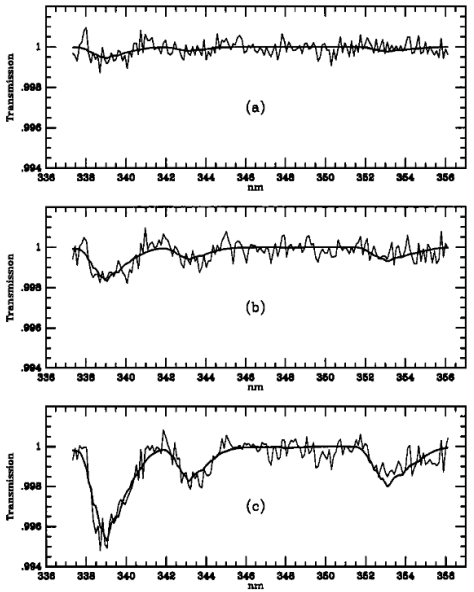
Algorithm

Spectrum Fit Algorithm

Derive Slant Column via direct spectral fit using TEMPO codebase



GOME HCHO Spec. Fit.



Chance et al. (2000)

Algorithm Flow

Key Datasets

Level 1 Radiance
Radiance Reference "I_0"

Algorithm

Spectrum Fit Algorithm

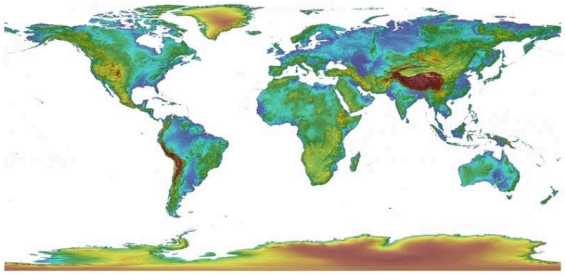
Elevation, Snow
Assim. Met + Chem

Retrieval PostProcessor

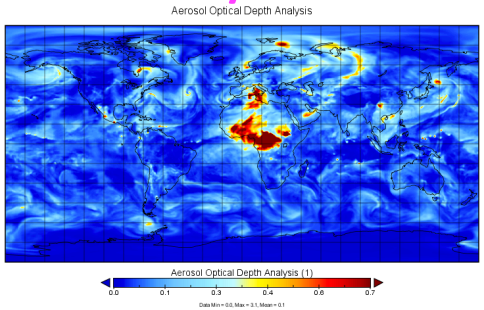
Append AMF Calculation inputs

Inputs sampled using instrument spatial PSF (Sun et. al.,2018)

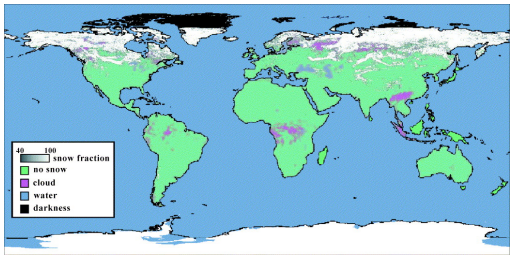
GMTED2010 Digital Elevation



MERRAv2 Aerosol/ Met/Gas



MODIS Snow and Ice



Algorithm Flow

Key Datasets

Level 1 Radiance
Radiance Reference "I_0"

GMTED 2010 DEM
MERRA/GMI Met/Gas/Aer

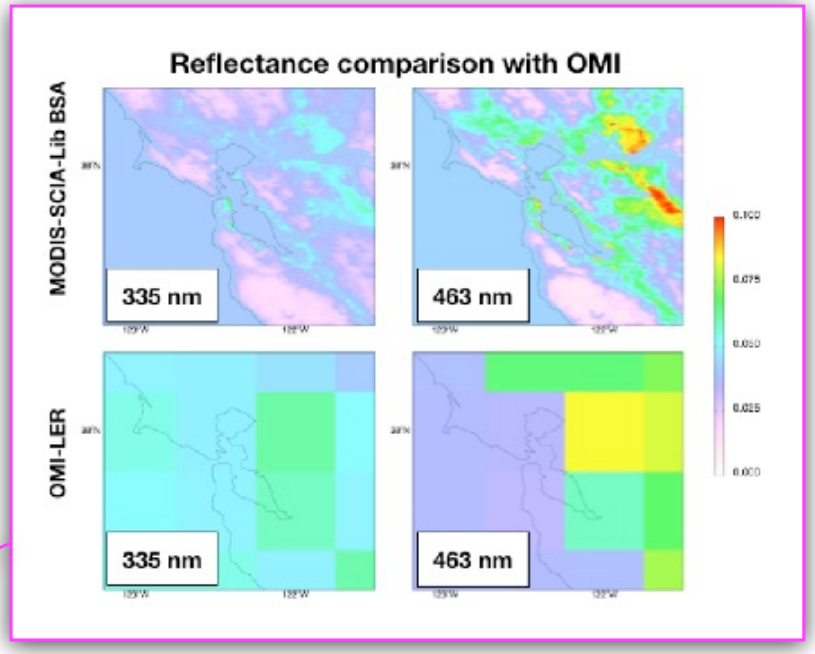
ProbPCA Extended MODIS
BRDF Kernels

Algorithm

Spectrum Fit Algorithm

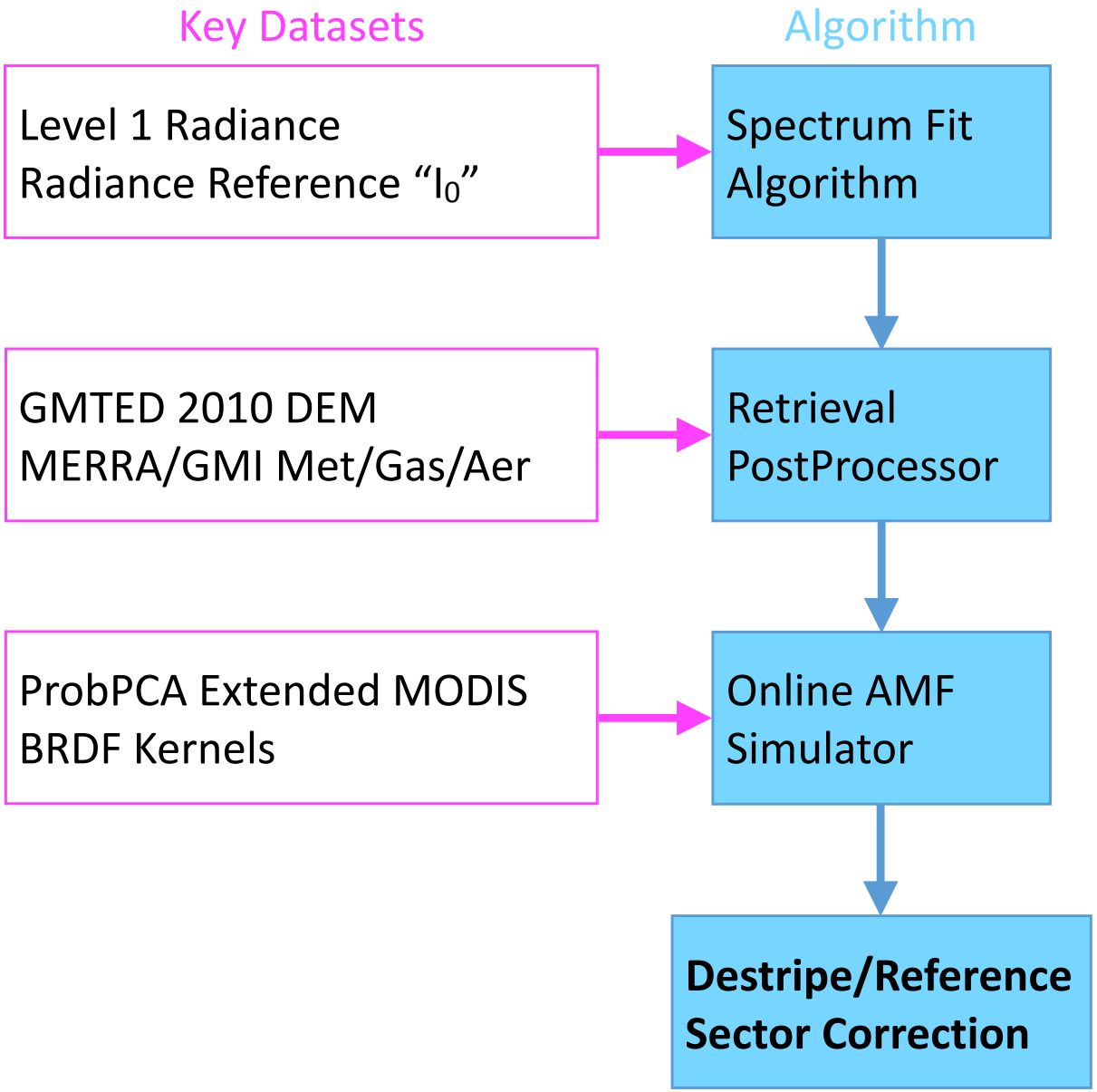
Retrieval PostProcessor

Online AMF Simulator



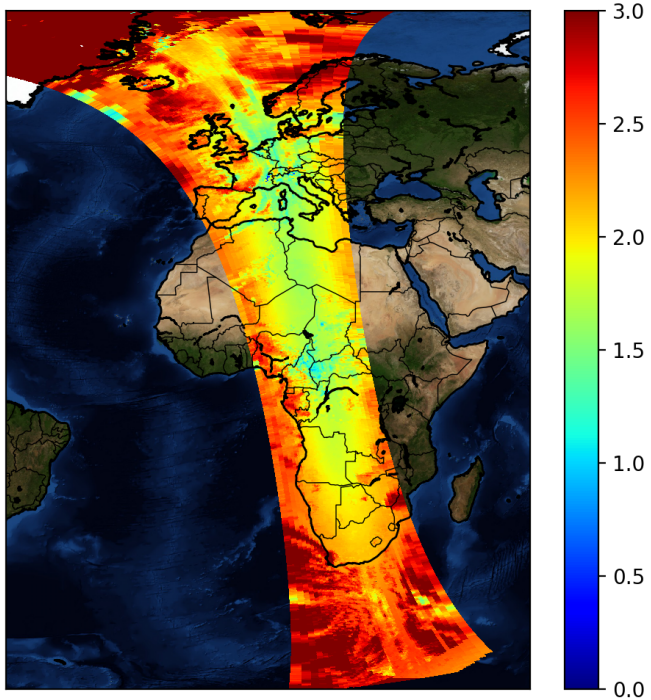
Computes AMF to infer VCD
+ uncertainty budget

Algorithm Flow

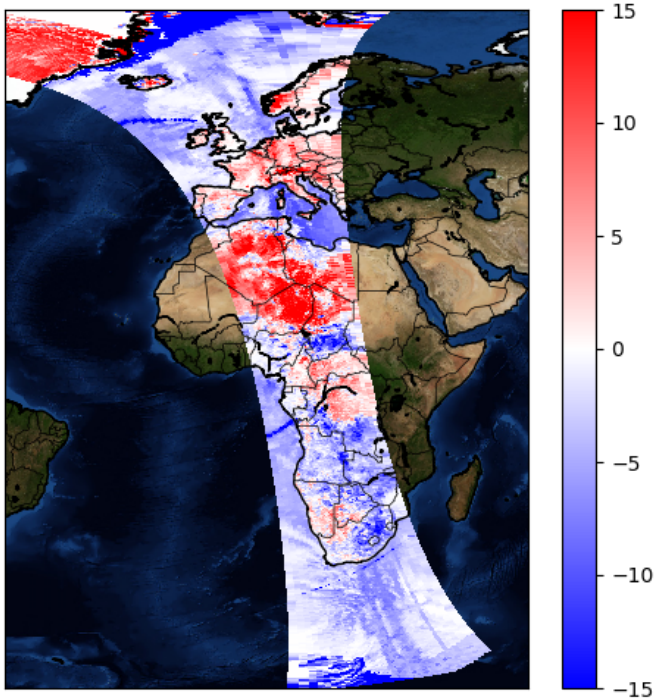


Testing the new stand-alone AMF Simulator

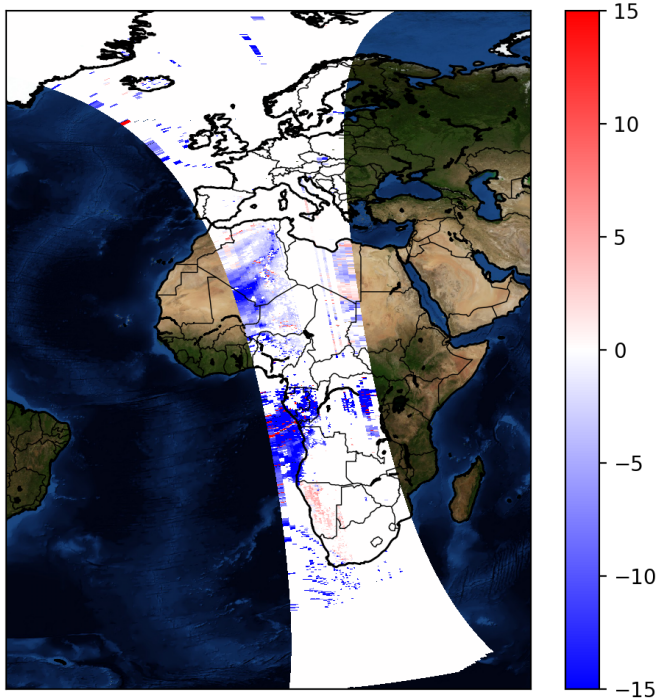
Standard OMI AMF



VCD Difference
MODIS_BRDF- Standard



VCD Difference
w/Aerosol - Standard



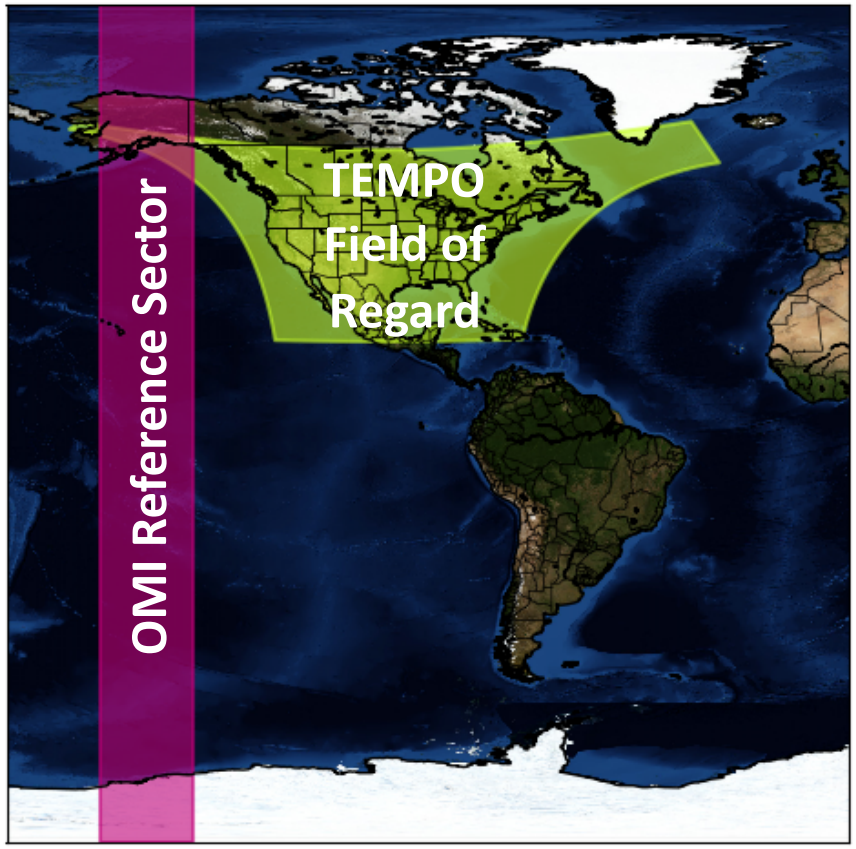
Next: Correct cloud products to account for inconsistent algorithm assumptions

<u>Observations</u>:
Radiance
O2 Slant Column

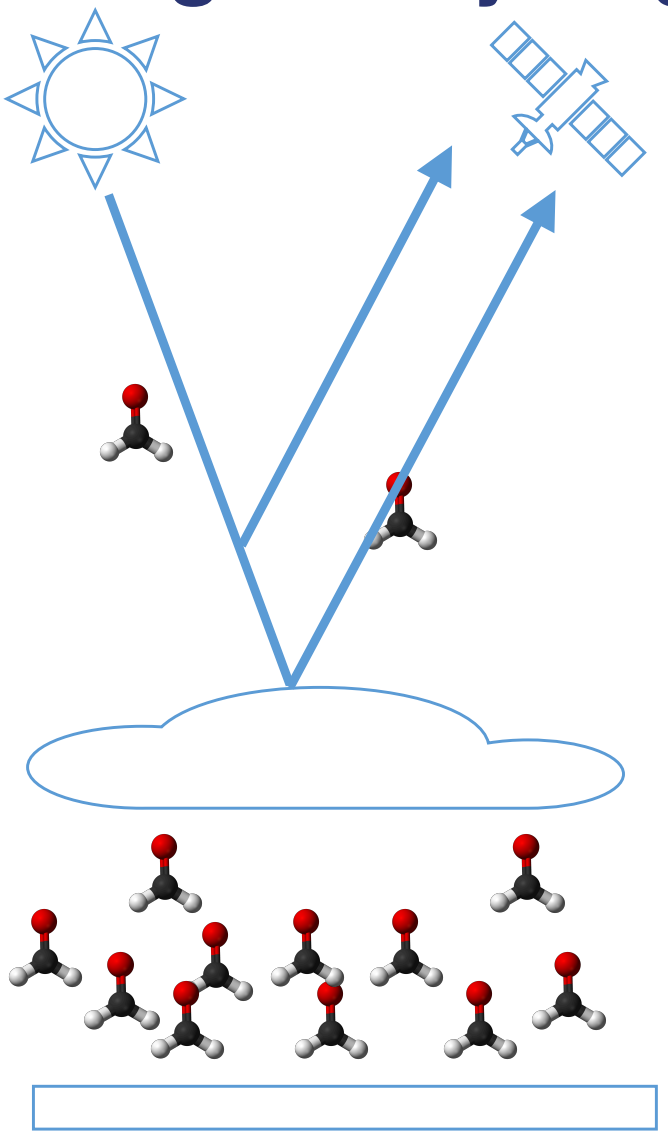
<u>State Elements:</u>
Surface Refl. (MODIS,Glint,Snow)
Aerosol
Lambertian Cloud Fraction/Pres.

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

Improved radiance references using cloudy targets



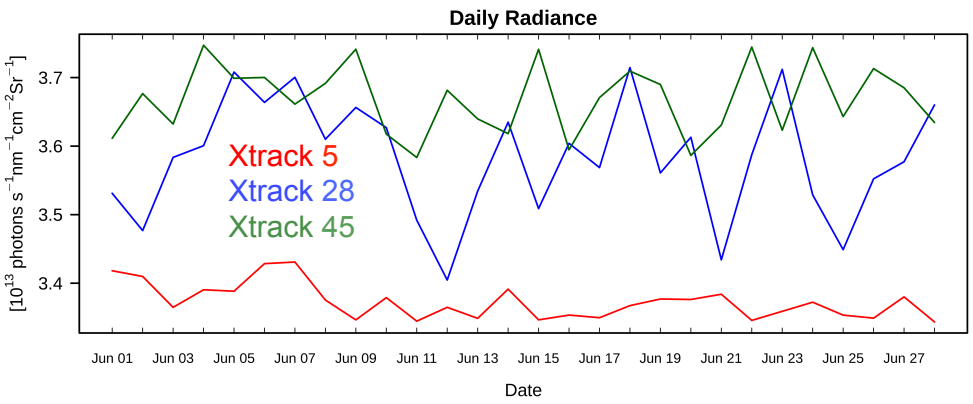
The typical radiance reference sector lies outside the TEMPO FOR



Using Clouds can shield boundary layer concentrations

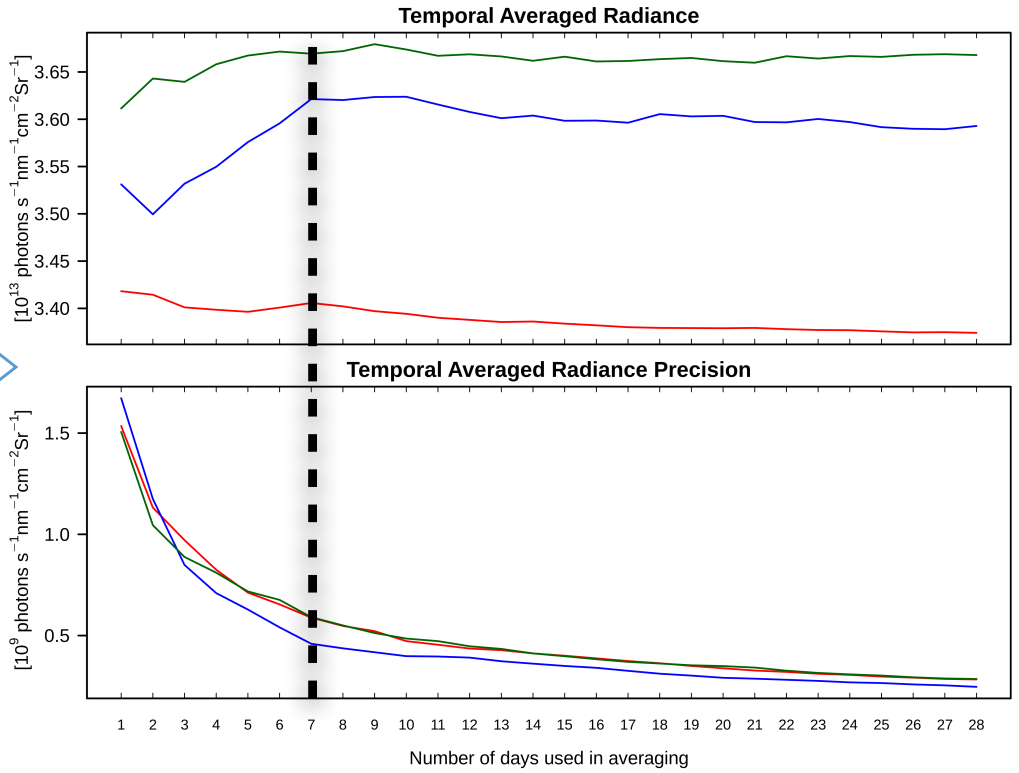
CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

Improved radiance references using cloudy targets



Radiances averaged for fully cloudy pixels between 700-800hPa

Radiances become stable after ~1 week averaging with high estimated precision (1x10^{-5})



CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

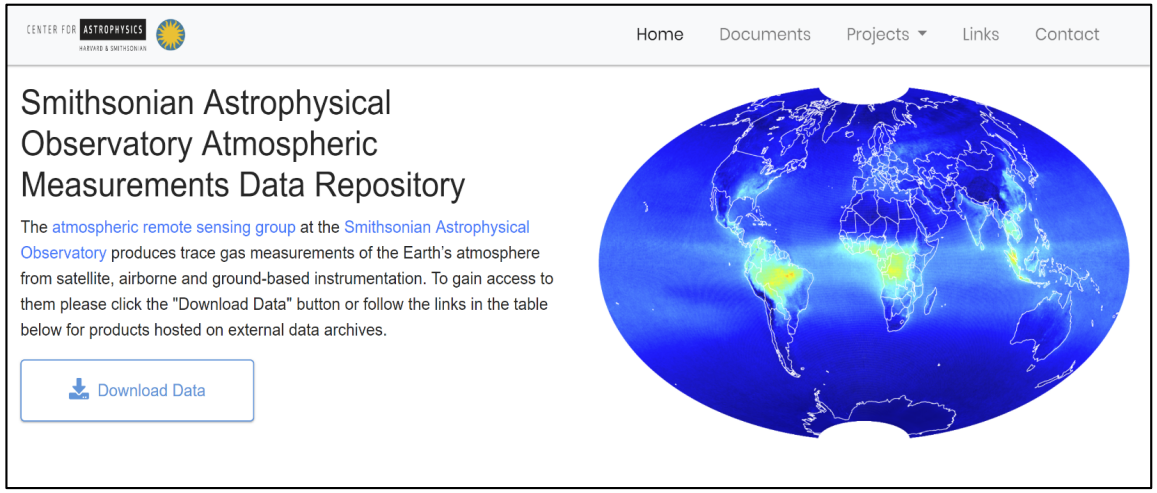
Project Timeline

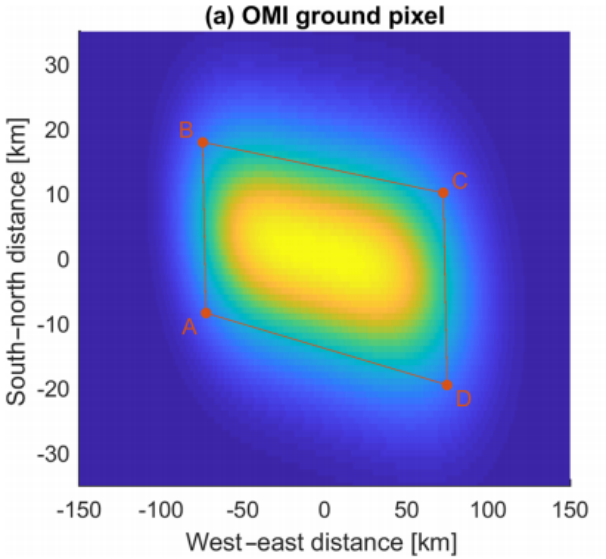
Initial release will be on the SAO Data Repo:

2021: OMI,GOME-2,OMPS

2023: GOME, SCIAMACHY

Final Release Hosted on GES-DISC





Release will include daily Level 3 Products with new physics-based oversampling with archived grid weights

Acknowledgments:
NASA support through ACMAP Aura, TASNPP, and MEaSUREs
OMI/Aura and TEMPO Science Teams

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN